

7.12 Noise and Vibration

7.12 NOISE AND VIBRATION

7.12.1 Introduction

This section describes noise- and vibration-sensitive receptors in the Affected Environment and includes the evaluation of potential Environmental Consequences of the Tier 1 Draft Environmental Impact Statement (Tier 1 Draft EIS) Action Alternatives on these resources.

7.12.1.1 Definition of Resource

Noise—typically defined as unwanted or undesirable sound—is generated by railway-related sources such as vehicle engines, wheel-rail interaction, and audible warning devices, including train horns, which may cause annoyance at nearby sensitive receptors. In the case of high-speed rail, aerodynamic noise can be generated when train speeds start to exceed 160 miles per hour (mph).

Vibration—defined as oscillatory motion—is generated by wheel-rail interaction from railway operations. Such vibration is transmitted through the track structure into the ground and may be perceptible and disturb people or sensitive activities in nearby buildings.

Appendix E, Section E.12, provides more-detailed definitions of noise and vibration.

7.12.1.2 Effects-Assessment Methodology

The Federal Railroad Administration (FRA) developed a specific effects-assessment methodology for each of the resource categories identified in the Noise and Vibration Impact Assessment Methodology, Appendix E. The methodology provides a detailed definition of each category, describes the data sources used for the evaluation, and explains how the Affected Environment was defined and established and how the effects on each resource were evaluated and reported. Table 7.12-1 summarizes key factors associated with the methodologies for each resource category evaluated.

Table 7.12-1: Methodological Summary: Noise and Vibration

Resource Category	Affected Environment	Type of Assessment	Outcome
Noise	5,000-foot-wide swath centered along Representative Route for each Action Alternative	Quantitative: Day-Night Sound Level, Ldn (dBA)	Estimated population within noise impact zones; presence of parks, ecologically sensitive habitats and cultural/historic properties within the Affected Environment potentially affected by the Representative Route of the Action Alternatives
Vibration		Quantitative: Vibration Velocity Level (VdB)	Estimated population within vibration impact zones; presence of parks, ecologically sensitive habitats and cultural/historic properties within the Affected Environment potentially affected by the Representative Route of the Action Alternatives

Source: NEC FUTURE Noise and Vibration Impact Assessment Methodology, Appendix E, Section E.12, 2014

Field measurements were not conducted for this Tier 1 analysis. All reported existing and future noise and vibration levels are estimates. Noise and vibration from rail sources were estimated using FRA and Federal Transit Administration (FTA) prediction models based on data for existing and future rail operations. The estimated noise from rail operations was combined with estimates of noise from

nearby major highways and airports, as well as estimates of typical levels of community background noise to estimate overall existing and future noise exposure levels.

7.12.2 Resource Overview

Within the Study Area, the areas of greatest concern for noise and vibration effects include densely populated areas, particularly those that are not currently within existing rail or highway corridors and therefore have lower existing noise and vibration levels. Within the Affected Environment of all the Action Alternatives, these areas include dense urban areas in Baltimore, Philadelphia, northern New Jersey, and New York City, as well as suburban areas in Long Island, NY, Westchester County, NY, and a number of communities in Connecticut. Areas with concentrations of other sensitive land use, such as parks, wildlife refuges and cultural/historic resources, are also of concern. Within the Affected Environment, locations where these resources are concentrated include Washington, D.C., Baltimore, Philadelphia, New York City, Providence, and Boston, as well as suburban and rural areas of Maryland, northern New Jersey, Long Island, coastal Connecticut, and rural areas of Connecticut, Rhode Island, and Massachusetts.

7.12.3 Affected Environment

Existing transportation-related noise and vibration sources within the Affected Environment include passenger trains, freight trains, highways, and airports. Land uses sensitive to noise and vibration within the Affected Environment include residential, institutional, and park lands. Table 7.12-2 summarizes these sensitive land uses by state and county. Appendix A, Mapping Atlas, includes graphics that identify various types of land use.

For purposes of this Tier 1 Draft EIS, the FRA did not identify detailed data on the specific uses at parks. As such, the FRA is considering all parks as potentially sensitive. Furthermore, the FRA did not identify specific community facilities such as churches, schools, or hospitals. During more-detailed Tier 2 analysis, specific park uses would be identified to determine if a park resource should be considered as a sensitive receptor and specific community facilities that may be affected by noise and vibration would be identified.

The FRA used a distance of 100 feet—a standard reference for railway noise and vibration in the United States—as a reference distance to estimate existing noise and vibration levels from the Representative Routes for the existing NEC and Action Alternatives.

Table 7.12-3 provides ranges for the existing noise and vibration levels by state and county, which represent conditions at sensitive receptors closest to the Representative Routes. (Appendix E, Section E.12, contains a more detailed description of the noise and vibration within the Affected Environment, including noise and vibration levels 50–800 feet from the Representative Routes.)

Table 7.12-2: Affected Environment: Noise and Vibration – Sensitive Land Uses

Geography	County	Noise- and Vibration-Sensitive Land Use
D.C.		Residences, schools, religious facilities, and parks
MD	Prince George's	Residences, schools, religious facilities, and parks
	Anne Arundel	Residences, religious facilities, and parks
	Baltimore	Residences, schools, religious facilities, cemeteries, hospital, and parks
	Harford	Residences, schools, religious facilities, and parks
	Cecil	Residences, schools, religious facilities, and parks
DE	New Castle	Residences, schools, religious facilities, health care center, prison, and parks
PA	Delaware	Residences, schools, religious facilities, and parks
	Philadelphia	Residences, schools, religious facilities, cemetery, hospital, prison, and parks
	Bucks	Residences, schools, religious facilities, cemeteries, and parks
NJ	Mercer	Residences, schools, religious facilities, and parks
	Middlesex	Residences, schools, religious facilities, and parks
	Union	Residences, schools, religious facilities, cemeteries, and parks
	Essex	Residences, schools, religious facilities, cemeteries, and parks
	Hudson	Residences, schools, religious facilities, and parks
NY	New York	Residences, schools, religious facilities, hospitals, hotels, and parks
	Kings	Residences
	Queens	Residences, schools, religious facilities, cemeteries, and parks
	Bronx	Residences, schools, religious facilities, hospital, hotel, and parks
	Westchester	Residences, schools, religious facilities, cemeteries, library, prison, and parks
	Putnam	Low-density residential development
	Nassau	Residences, schools, religious facilities, and parks
	Suffolk	Residences, schools, religious facilities, cemeteries, and parks
CT	Fairfield	Residences, schools, religious facilities, hotels, cemeteries, hospitals, and parks
	New Haven	Residences, schools, religious facilities, hospitals, cemeteries, hotel, library, performing arts center, and parks
	Hartford	Residences, schools, religious facilities, cemeteries, hospitals, and parks
	Tolland	Residences, schools, religious facilities, and parks
	Windham	Residences
	Middlesex	Residences, schools, religious facilities, and parks
	New London	Residences, schools, religious facilities, hospitals, hotels, and parks
RI	Washington	Residences, schools, religious facilities, medical facilities, cemeteries, and parks
	Kent	Residences, school, religious facility, library, and hotels
	Providence	Residences, schools, religious facilities, hospitals, hotel, prison, cemetery, library, parks, and the Rhode Island State House
MA	Bristol	Residences, schools, and religious facilities
	Worcester	Residences, schools, religious facilities, hotels, hospitals, cemeteries, library, theater, and parks
	Middlesex	Residences, schools, religious facilities, and a hospital
	Norfolk	Residences, schools, religious facilities, cemeteries, and parks
	Suffolk	Residences, schools, religious facilities, hospitals, and parks

Source: NEC FUTURE team, 2015

Table 7.12-3: Affected Environment: Noise and Vibration – Existing Levels

Geography	County	Noise Exposure (Ldn) at 100 ft. from Representative Route (dBA)				Max. Vibration Velocity Level at 100 ft. from Representative Route (VdB)			
		Existing NEC	Alt. 1	Alt. 2	Alt. 3	Existing NEC	Alt. 1	Alt. 2	Alt. 3
D.C.		68	68	68–69	69	87	87	87	87
MD	Prince George's	72	72	72–73	72–73	87	87	87	87
	Anne Arundel	72	72	72	72	87	87	87	87
	Baltimore Co.	72–75	72–75	72–75	66–75	87	87	87	61–87
	Baltimore City	60–71	60–71	60–71	60–71	87	50–87	50–87	50–87
	Harford	71–75	71–75	71–75	66–75	87	87	87	50–87
	Cecil	74–75	74–75	50–75	50–75	87	87	50–87	50–87
DE	New Castle	66–74	66–74	55–74	55–74	87	87	87	50–87
PA	Delaware	66–70	66–70	66–70	60–70	87	87	79–87	50–87
	Philadelphia	60–68	60–68	60–69	60–72	87	87	79–87	50–87
	Bucks	71–72	71–72	71–72	71–72	87	87	87	87
NJ	Mercer	68–73	68–73	69–73	68–73	87	87	87	77–87
	Middlesex	69–74	69–74	55–74	55–74	87	87	50–87	50–87
	Union	75	75	70–75	73–75	87	87	87	87
	Essex	70–71	70–71	70–71	70–71	87	87	87	87
	Hudson	60–75	60–75	60–75	55–75	87	87	87	50–87
NY	New York	60–73	60–73	60–73	60–73	77–87	77–87	77–87	50–87
	Kings	—	—	—	60	—	—	—	50
	Queens	60–68	60–68	60–68	60–68	77–87	77–87	50–87	50–87
	Bronx	65–68	65–68	65–68	60–69	77–87	77–87	77–87	50–87
	Westchester	70–71	70–71	66–71	50–71	87	87	61–87	50–87
	Putnam	—	—	—	50	—	—	—	50
	Nassau	—	—	—	55–71	—	—	—	50–74
	Suffolk	—	—	—	55–72	—	—	—	50–74
CT	Fairfield	65–71	65–71	55–71	55–71	87	87	61–87	50–87
	New Haven	55–70	55–70	55–70	50–70	87	87	50–87	50–87
	Hartford	—	—	55–66	55–66	87	87	50–79	50–79
	Tolland	—	—	50–55	50–66	87	87	50	50–61
	Windham	—	—	50	50–66	—	—	50–61	50–61
	Middlesex	68	68	68	68	87	87	87	87
	New London	66–75	50–75	66–75	66–75	87	50–87	87	87
	Washington	66–69	50–69	66–69	66–69	87	50–87	87	87
RI	Kent	69–71	69–71	69–71	69–71	87	87	87	87
	Providence	60–71	60–71	50–71	50–71	87	87	50–87	50–87
	Bristol	68	68	66–68	66–68	87	87	79–87	79–87
MA	Worcester	—	—	—	50–66	87	87	—	50–79
	Middlesex	—	—	—	55–69	87	87	—	50–79
	Norfolk	67–68	67–68	67–68	65–68	87	87	87	79–87
	Suffolk	60–68	60–68	60–68	60–68	87	87	87	61–87

Source: NEC FUTURE team, 2015

— = Representative Route is not applicable to state and county.

Predicted noise and vibration levels vary by specific location along the Representative Routes because of differences in rail operations and the presence or absence of other noise and vibration sources; therefore, some of the results in Table 7.12-3 exhibit wide ranges in noise and vibration levels within a given county. For example, in areas adjacent to routes that are not along rail or highway corridors, existing noise and vibration levels are much lower than in other areas where there are major sources of noise and vibration.

7.12.3.1 Existing NEC

As shown in Table 7.12-3, the existing noise levels at a distance of 100 feet from the existing NEC are fairly high, with noise exposure levels (Ldn) that are typically in the range of 65–75 dBA. To put these levels into perspective, the Department of Housing and Urban Development defines an Ldn of 65 dBA as the onset of a normally unacceptable housing environment, and the Federal Aviation Administration considers residential land uses not compatible with noise environments where Ldn is greater than 65 dBA. Along the existing NEC, noise levels are generally highest in Maryland, Delaware, and New Jersey, and lowest in Washington, D.C., and Massachusetts.

For vibration, Table 7.12-3 indicates existing maximum levels of 77–87 VdB at 100 feet from the existing NEC, above the FRA/FTA criteria of 72–75 VdB for residential land use based on the current train volumes. The maximum vibration levels along this route are similar in all states.

7.12.3.2 Alternative 1

The existing noise and vibration level ranges along the Representative Route for Alternative 1 are the same as those along the existing NEC, except in a few areas along new off-corridor routes where there are no major existing noise and vibration sources and where the existing levels are low.

7.12.3.3 Alternative 2

The existing noise and vibration level ranges along the Representative Route for Alternative 2 are typically 0–1 dB higher than those along the routes for the existing NEC and Alternative 1, except in areas along new off-corridor routes where the noise and vibration levels from existing sources are lower.

7.12.3.4 Alternative 3

The upper limits of the existing noise level ranges along the Representative Route for Alternative 3 are 0–1 dB higher than along the existing NEC and the routes for the other alternatives, except in Philadelphia County where they are 3–4 dB higher. The minimum noise levels for Alternative 3 are generally lower than for the other alternatives in areas where there are new off-corridor route options. For vibration, the upper end of the existing range is the same as for the existing NEC in most counties, and the lower end of the range typically represents the existing vibration levels along new route options.

7.12.4 Environmental Consequences

To determine effects, this analysis focused on identifying the population within the projected noise and vibration impact zones for the Representative Routes. Areas of severe and moderate noise

impact and areas of vibration impact were determined based on the estimated existing and future noise and vibration levels using applicable FRA/FTA prediction methods and criteria. The populations with potential impacts were then identified based on census tract data for the impact areas. The following sections discuss the key findings of the Environmental Consequences analysis.

7.12.4.1 No Action Alternative

Except for a few minor differences in train equipment, operations under the No Action Alternative are expected to be the same as for the existing conditions; therefore, no new noise or vibration impacts will occur.

7.12.4.2 Action Alternatives

Table 7.12-4 summarizes by state and county the future noise and vibration conditions in terms of the estimated changes in noise and vibration levels (from existing to future conditions) at a distance of 100 feet from the Representative Routes for the Action Alternatives. These results typically indicate projected increases in noise and vibration levels, with the greatest increases for Alternative 3 and locations with no existing trains. However, in some cases, the results project decreases in noise or vibration levels caused by future changes in train equipment and operations.

Because noise and vibration impact depend on both existing and future levels according to FRA/FTA criteria, the estimated ranges of level changes in Table 7.12-4 are not always directly indicative of potential impact. For example, noise impact can occur even when the projected noise increase is small if the existing noise levels are very high. In the case of vibration, the future levels must exceed the criteria for impact to occur, which may require large increases in areas where the existing levels are imperceptible and well below the limit. Thus, to supplement the information in the table, the counties that include areas where impact is projected are highlighted in the table for each of the Action Alternatives. Specifically, the counties that include areas of noise and vibration impact are indicated by gray shading, and bold type font is used to indicate those with areas of severe noise impact. These results suggest that Alternative 1 would have the fewest impacts, with a route and operations that are most similar to the existing conditions, and that Alternative 3, which includes a number of new route options and higher speed train operations, would have the most impacts. The specific areas of impacts for the Action Alternatives are shown in Appendix A, Mapping Atlas.

Table 7.12-5 lists by state and county the estimated populations within the projected FRA/FTA severe and moderate noise impact zones for the Action Alternatives. Table 7.12-6 and Table 7.12-7 provide breakdowns by area of the projected severe and moderate residential impacts, respectively, for the Alternative 3 route options.

Table 7.12-8 lists by state and county the estimated populations within the projected FRA/FTA vibration impact zones for the Action Alternatives, and Table 7.12-9 provides breakdowns by area of the projected residential vibration impacts for the Alternative 3 route options.

In addition to residential population, Table 7.12-10 and Table 7.12-11 summarize the related resources—including parks, ecologically sensitive habitats, and cultural resources/historic properties—that could be affected by noise and vibration, respectively. These tables note by state and county the presence of related resources where residential impacts exist within the Affected

Environment of the Action Alternatives. The vibration impacts apply only to resources that contain building structures and do not apply to open land. See Appendix E, Section E.12, for a more detailed description of the Environmental Consequences for noise and vibration.

Table 7.12-4: Environmental Consequences: Noise and Vibration – Future Conditions

Geography	County	Change in Noise Exposure (Ldn) at 100 ft. from Representative Route (dBA)			Change in Maximum Vibration Level at 100 ft. from Representative Route (VdB)		
		Alt. 1	Alt. 2	Alt. 3	Alt. 1	Alt. 2	Alt. 3
D.C.		2	2 to 3	5	0	0	0
MD	Prince George's	2	2 to 3	5 to 10	0	0	0
	Anne Arundel	2	3	1 to 6	0	0	0
	Baltimore Co.	1 to 2	1 to 3	-1 to 6	0	0	0 to 14
	Baltimore City	0 to 2	-3 to 3	0 to 8	0 to 37	0 to 37	0 to 37
	Harford	1	-3 to 2	-1 to 27	0	0	0 to 35
	Cecil	0 to 1	-1 to 26	-1 to 31	0	-2 to 37	0 to 35
DE	New Castle	1 to 2	-1 to 3	-1 to 17	0	-2 to 0	0 to 35
PA	Delaware	1 to 2	-5 to 10	2 to 12	0	-8 to 8	0 to 30
	Philadelphia	0 to 2	-3 to 6	2 to 8	0	-8 to 8	0 to 30
	Bucks	1 to 2	2 to 3	6 to 7	0	0	0
NJ	Mercer	1	1 to 2	5 to 7	0	0	0
	Middlesex	1	-3 to 13	0 to 15	0	0 to 35	-2 to 37
	Union	0	-4 to 1	2 to 7	0	0	-2 to 0
	Essex	1 to 2	-2 to 4	1 to 6	0	0	0
	Hudson	2	3	0 to 15	0	0	-2 to 37
NY	New York	3	5	7	0	0	0 to 37
	Kings	—	—	0	—	—	30
	Queens	3	2 to 8	0 to 8	0	0 to 37	0 to 37
	Bronx	1 to 4	2 to 6	1 to 16	0	0	0 to 10
	Westchester	3 to 4	4 to 10	5 to 26	0	0 to 26	0 to 30
	Putnam	—	—	0	—	—	30
	Nassau	—	—	0 to 16	—	—	6 to 30
	Suffolk	—	—	-6 to 24	—	—	0 to 30
CT	Fairfield	3 to 8	-2 to 10	0 to 23	0	-8 to 26	-8 to 37
	New Haven	2 to 4	1 to 20	3 to 26	0	-8 to 17	-7 to 30
	Hartford	—	2 to 11	6 to 25	—	0 to 27	1 to 30
	Tolland	—	15 to 20	6 to 26	—	27	9 to 30
	Windham	—	15 to 24	21 to 30	—	17 to 27	20 to 30
	Middlesex	3	1	3 to 5	0	-8	-7
	New London	-2 to 21	-1 to 1	1 to 7	0 to 27	-8	-7
RI	Washington	-1 to 21	0 to 2	1 to 7	0 to 27	-8 to -2	-7 to -2
	Kent	2 to 3	1 to 2	2 to 5	0	-2	-2
	Providence	2 to 3	1 to 20	2 to 26	0	-2 to 27	-7 to 35
MA	Bristol	4	3 to 5	4 to 11	0	-2 to 0	-2 to 6
	Worcester	—	—	6 to 21	—	—	0 to 35
	Middlesex	—	—	0	—	—	6 to 35
	Norfolk	4 to 5	5 to 7	6 to 15	0	-2	-2 to 6
	Suffolk	2 to 4	3 to 6	3 to 11	0	-2 to 0	-2 to 24

Source: NEC FUTURE team, 2015

Note: A value of "0" indicates that no projected FRA/FTA severe or moderate noise impact zones occur in that county.

— = Representative Route is not applicable to state and county.

Gray shading = Areas with noise or vibration impact.

Bold type font = Areas with severe noise impact.

Table 7.12-5: Environmental Consequences: Representative Route – Noise – Residential Impacts

Geography	County	Estimated Population within Severe Noise Impact Zones			Estimated Population within Moderate Noise Impact Zones		
		Alt. 1	Alt. 2	Alt. 3	Alt. 1	Alt. 2	Alt. 3
D.C.		0	8,570	21,790	13,170	14,090	17,380
MD	Prince George's	0	21,480	79,980	31,850	52,300	73,190
	Anne Arundel	0	16,840	34,240	22,180	30,910	34,960
	Baltimore Co.	0	11,190	43,400	26,150	38,670	43,090
	Baltimore City	0	17,930	7,860	25,900	32,130	23,090
	Harford	0	0	73,740	13,510	17,500	59,770
	Cecil	0	16,140	43,550	9,540	29,520	90,300
DE	New Castle	0	19,100	71,870	41,720	60,070	79,710
PA	Delaware	0	10,720	46,790	47,930	13,500	64,470
	Philadelphia	0	71,960	151,280	109,330	96,000	143,470
	Bucks	0	5,720	58,920	18,360	47,610	66,710
NJ	Mercer	0	6,650	53,890	18,320	32,790	48,450
	Middlesex	0	10,080	107,870	64,140	133,130	141,500
	Union	0	9,000	115,880	61,690	41,910	167,350
	Essex	11,730	1,680	32,100	18,830	2,460	28,340
	Hudson	3,830	4,940	18,520	10,520	11,640	19,890
NY	New York	1,630	3,260	4,710	3,320	3,720	4,200
	Kings	—	—	0	—	—	0
	Queens	34,150	75,760	87,880–192,860	44,770	58,090	90,330–209,650
	Bronx	59,570	89,180	123,470–222,190	76,750	96,060	158,570–243,470
	Westchester	58,130	107,300	123,370–303,720	97,580	139,750	122,450–191,090
	Putnam	—	—	0	—	—	0
	Nassau	—	—	0–49,110	—	—	0–49,500
	Suffolk	—	—	0–29,740	—	—	0–24,400
CT	Fairfield	123,380	170,700	156,110–174,780	169,240	199,490	146,440–161,450
	New Haven	47,480	60,920	90,880–157,990	74,050	90,830	108,220–150,490
	Hartford	—	56,410	46,840–66,340	—	66,710	51,260–60,790
	Tolland	—	2,890	7,890–31,940	—	4,800	14,180–51,850
	Windham	—	4,050	1,020–15,130	—	6,530	2,130–24,580
	Middlesex	2,190	0	3,140–5,700	5,950	0	6,240–8,670
	New London	9,990	0	17,680–31,650	19,270	3,540	36,000–47,610
	Washington	8,800	0	8,340–18,280	18,520	2,680	20,690–36,910
RI	Kent	5,330	0	7,950–15,040	15,740	12,400	16,610–20,950
	Providence	28,770	22,800	71,920–73,610	73,680	71,080	83,480–131,070
	Bristol	19,790	23,910	33,150–58,000	25,210	38,880	33,540–40,090
MA	Worcester	—	—	107,920	—	—	115,470
	Middlesex	—	—	120	—	—	280
	Norfolk	14,270	18,870	29,010–45,450	16,540	24,210	24,170–27,680
	Suffolk	73,480	86,790	156,130–219,140	76,890	112,520	123,390–190,520
TOTAL		502,520	954,840	2,245,530–2,477,490	1,250,650	1,585,520	2,405,040–2,633,920

Source: NEC FUTURE team, 2015

Note: A value of "0" indicates that no projected FRA/FTA severe or moderate noise impact zones occur in that county.

— = Representative Route is not applicable to state and county.

Table 7.12-6: Environmental Consequences: Representative Route of Alternative 3 Route Options – Noise – Severe Residential Impacts

Geography	County	Estimated Population Within Severe Noise Impact Zones				
		D.C. to NYC	New York City to Hartford		Hartford to Boston	
			via Central Connecticut	via Long Island	via Providence	via Worcester
D.C.		21,790	—	—	—	—
MD	Prince George's	79,980	—	—	—	—
	Anne Arundel	34,240	—	—	—	—
	Baltimore Co.	43,400	—	—	—	—
	Baltimore City	7,860	—	—	—	—
	Harford	73,740	—	—	—	—
	Cecil	43,550	—	—	—	—
DE	New Castle	71,870	—	—	—	—
PA	Delaware	46,790	—	—	—	—
	Philadelphia	151,280	—	—	—	—
	Bucks	58,920	—	—	—	—
NJ	Mercer	53,890	—	—	—	—
	Middlesex	107,870	—	—	—	—
	Union	115,880	—	—	—	—
	Essex	32,100	—	—	—	—
	Hudson	18,520	—	—	—	—
NY	New York	—	4,710	4,710	—	—
	Kings	—	—	0	—	—
	Queens	—	87,880	192,860	—	—
	Bronx	—	222,190	123,470	—	—
	Westchester	—	303,720	123,370	—	—
	Putnam	—	0	—	—	—
	Nassau	—	—	49,110	—	—
	Suffolk	—	—	29,540	—	—
CT	Fairfield	—	174,780	156,110–157,060	—	—
	New Haven	—	90,880–109,280	145,760–157,990	—	—
	Hartford	—	—	38,980	26,340–27,360	15,310
	Tolland	—	—	—	7,890	31,940
	Windham	—	—	—	11,250–15,130	1,020
	Middlesex	—	—	—	3,140	5,700
	New London	—	—	—	17,680–17,910	31,490–31,650
	Washington	—	—	—	8,340–8,610	18,120–18,280
RI	Kent	—	—	—	7,950	15,040
	Providence	—	—	—	73,150–73,610	71,920
MA	Bristol	—	—	—	57,980–58,000	33,150–33,170
	Worcester	—	—	—	—	107,920
	Middlesex	—	—	—	—	120
	Norfolk	—	—	—	41,390–45,450	29,010–33,770
	Suffolk	—	—	—	156,130–159,680	216,040–219,140
TOTAL		953,820	915,690–934,090	863,910–877,090	411,240–424,730	576,780–584,980

Source: NEC FUTURE team, 2015

— = Representative Route is not applicable to state and county.

Table 7.12-7: Environmental Consequences: Representative Route of Alternative 3 Route Options – Noise – Moderate Residential Impacts

Geography	County	Estimated Population Within Moderate Noise Impact Zones				
		D.C. to NYC	New York City to Hartford		Hartford to Boston	
			via Central Connecticut	via Long Island	via Providence	via Worcester
D.C.		17,380	—	—	—	—
MD	Prince George's	73,190	—	—	—	—
	Anne Arundel	34,960	—	—	—	—
	Baltimore Co.	43,090	—	—	—	—
	Baltimore City	23,090	—	—	—	—
	Harford	59,770	—	—	—	—
	Cecil	90,300	—	—	—	—
DE	New Castle	79,710	—	—	—	—
PA	Delaware	64,470	—	—	—	—
	Philadelphia	143,470	—	—	—	—
	Bucks	66,710	—	—	—	—
NJ	Mercer	48,450	—	—	—	—
	Middlesex	141,500	—	—	—	—
	Union	167,350	—	—	—	—
	Essex	28,340	—	—	—	—
	Hudson	19,890	—	—	—	—
NY	New York	—	4,200	4,200	—	—
	Kings	—	—	0	—	—
	Queens	—	90,330	209,650	—	—
	Bronx	—	243,470	158,570	—	—
	Westchester	—	191,090	122,450	—	—
	Putnam	—	0	—	—	—
	Nassau	—	—	49,500	—	—
	Suffolk	—	—	24,400	—	—
CT	Fairfield	—	161,210–161,450	146,440–147,390	—	—
	New Haven	—	108,220–126,330	132,130–150,490	—	—
	Hartford	—	36,720	33,440	23,460–24,070	17,820
	Tolland	—	—	—	14,180–17,110	51,850
	Windham	—	—	—	16,330–24,580	2,130
	Middlesex	—	—	—	6,240	8,580 – 8,670
	New London	—	—	—	36,000–36,140	47,550–47,610
RI	Washington	—	—	—	20,690–21,070	36,700–36,910
	Kent	—	—	—	16,610	20,950
	Providence	—	—	—	116,820–131,070	83,480
MA	Bristol	—	—	—	40,070–40,090	33,540–33,550
	Worcester	—	—	—	—	115,470
	Middlesex	—	—	—	—	280
	Norfolk	—	—	—	26,450–27,680	24,170–25,430
	Suffolk	—	—	—	123,390–125,840	186,770–190,520
TOTAL		1,078,580	835,240–853,590	880,780–900,090	440,240–470,500	629,290–634,670

Source: NEC FUTURE team, 2015

Note: A value of "0" indicates that no projected FRA/FTA severe or moderate noise impact zones occur in that county.

— = Representative Route is not applicable to state and county.

Table 7.12-8: Environmental Consequences: Representative Route – Vibration – Residential Impacts

Geography	County	Estimated Population Within Vibration Impact Zones		
		Alternative 1	Alternative 2	Alternative 3
D.C.		0	0	0
MD	Prince George's	0	0	0
	Anne Arundel	0	0	0
	Baltimore Co.	0	0	13,200
	Baltimore City	54,570	54,570	180,130
	Harford	0	0	17,950
	Cecil	0	8,250	7,170
DE	New Castle	0	3,700	20,990
PA	Delaware	0	4,090	950
	Philadelphia	0	32,620	142,580
	Bucks	0	0	0
NJ	Mercer	0	0	0
	Middlesex	0	42,750	22,540
	Union	0	0	0
	Essex	0	0	0
	Hudson	0	0	80,720
NY	New York	0	2,370	106,430–340,710
	Kings	—	—	6,670
	Queens	0	188,790	183,770–319,640
	Bronx	0	0	0–1,230
	Westchester	0	8,380	0–34,090
	Putnam	—	—	0–2,040
	Nassau	—	—	0–85,260
	Suffolk	—	—	0–103,880
CT	Fairfield	0	74,030	38,970–51,500
	New Haven	0	7,630	19,880–22,900
	Hartford	—	5,590	49,370–57,520
	Tolland	—	3,940	5,130–5,530
	Windham	—	1,910	140–2,490
	Middlesex	50	0	0
	New London	11,920	0	0
	Washington	3,940	0	0
RI	Kent	0	0	0
	Providence	0	44,480	0–76,330
MA	Bristol	0	0	0–3,960
	Worcester	—	—	32,460
	Middlesex	—	—	66,700
	Norfolk	0	0	5,410
	Suffolk	0	0	0–127,960
TOTAL		70,480	483,100	1,267,610–1,415,850

Source: NEC FUTURE team, 2015

Note: A value of "0" indicates that no projected FRA/FTA severe or moderate noise impact zones occur in that county.

— = Representative Route is not applicable to state and county.

Table 7.12-9: Environmental Consequences: Representative Route of Alternative 3 Route Options – Vibration – Residential Impacts

Geography	County	Estimated Population Within Vibration Impact Zones				
		D.C. to NYC	New York City to Hartford		Hartford to Boston	
			via Central Connecticut	via Long Island	via Providence	via Worcester
D.C.		0	—	—	—	—
MD	Prince George's	0	—	—	—	—
	Anne Arundel	0	—	—	—	—
	Baltimore Co.	13,200	—	—	—	—
	Baltimore City	180,130	—	—	—	—
	Harford	17,950	—	—	—	—
	Cecil	7,170	—	—	—	—
DE	New Castle	20,990	—	—	—	—
PA	Delaware	950	—	—	—	—
	Philadelphia	142,580	—	—	—	—
	Bucks	0	—	—	—	—
NJ	Mercer	0	—	—	—	—
	Middlesex	22,540	—	—	—	—
	Union	0	—	—	—	—
	Essex	0	—	—	—	—
	Hudson	80,720	—	—	—	—
NY	New York	—	340,710	106,430	—	—
	Kings	—	—	6,670	—	—
	Queens	—	183,770	319,640	—	—
	Bronx	—	1,230	0	—	—
	Westchester	—	34,090	0	—	—
	Putnam	—	2,040	—	—	—
	Nassau	—	—	85,260	—	—
	Suffolk	—	—	103,880	—	—
CT	Fairfield	—	51,500	38,970	—	—
	New Haven	—	22,900	19,880	—	—
	Hartford	—	45,480	39,610	6,110–17,910	9,750
	Tolland	—	—	—	5,130	5,530
	Windham	—	—	—	2,490	140
	Middlesex	—	—	—	0	0
	New London	—	—	—	0	0
RI	Washington	—	—	—	0	0
	Kent	—	—	—	0	0
	Providence	—	—	—	76,040–76,330	0
MA	Bristol	—	—	—	3,820–3,960	0
	Worcester	—	—	—	—	32,460
	Middlesex	—	—	—	—	66,700
	Norfolk	—	—	—	0	5,410
	Suffolk	—	—	—	0	127,960
TOTAL		306,100	681,720	720,340	93,590–105,820	247,950

Source: NEC FUTURE team, 2015

Note: A value of "0" indicates that no projected FRA/FTA severe or moderate noise impact zones occur in that county.

— = Representative Route is not applicable to state and county.

Table 7.12-10: Environmental Consequences: Affected Environment – Noise – Summary of Related Resources

Geography	County	Resource of Interest	Summary of Related Resources						
			Alt. 1	Alt. 2	DC-NYC	Alternative 3			
						New York City to Hartford		Hartford to Boston	
						Central CT	Long Island	Providence	Worcester
D.C.		Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
MD	Prince George's	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties							
	Anne Arundel	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
	Baltimore County	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
	Baltimore City	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
	Harford	Parks	X	X	X				
		Ecologically Sensitive Habitat	X		X				
		Cultural/Historic Properties	X	X	X				
	Cecil	Parks	X	X	X				
		Ecologically Sensitive Habitat	X		X				
		Cultural/Historic Properties	X	X	X				
DE	New Castle	Parks	X	X	X				
		Ecologically Sensitive Habitat			X				
		Cultural/Historic Properties	X	X	X				
PA	Delaware	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
	Philadelphia	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
	Bucks	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				

Table 7.12-10: Environmental Consequences: Affected Environment – Noise – Summary of Related Resources (continued)

Geography	County	Resource of Interest	Summary of Related Resources						
			Alt. 1	Alt. 2	DC-NYC	Alt. 3			
						New York City to Hartford		Hartford to Boston	
						Central CT	Long Island	Providence	Worcester
NJ	Mercer	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
	Middlesex	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
	Union	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
	Essex	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
NY	New York	Parks	X	X		X	X		
		Ecologically Sensitive Habitat	X	X		X	X		
		Cultural/Historic Properties	X	X		X	X		
	Queens	Parks	X	X		X	X		
		Ecologically Sensitive Habitat	X	X		X	X		
		Cultural/Historic Properties	X	X		X	X		
	Bronx	Parks	X	X		X	X		
		Ecologically Sensitive Habitat	X	X		X	X		
		Cultural/Historic Properties	X	X		X	X		
	Westchester	Parks				X			
		Ecologically Sensitive Habitat	X	X		X	X		
		Cultural/Historic Properties	X	X		X	X		
	Nassau	Parks					X		
		Ecologically Sensitive Habitat					X		
		Cultural/Historic Properties					X		
	Suffolk	Parks					X		
		Ecologically Sensitive Habitat					X		
		Cultural/Historic Properties					X		
CT	Fairfield	Parks	X	X		X	X		
		Ecologically Sensitive Habitat	X	X		X	X		
		Cultural/Historic Properties	X	X		X	X		
	New Haven	Parks	X	X		X	X		
		Ecologically Sensitive Habitat	X	X		X	X		
		Cultural/Historic Properties	X	X		X	X		

Table 7.12-10: Environmental Consequences: Affected Environment – Noise – Summary of Related Resources (continued)

Geography	County	Resource of Interest	Summary of Related Resources						
			Alt. 1	Alt. 2	DC-NYC	Alt. 3			
						New York City to Hartford		Hartford to Boston	
						Central CT	Long Island	Providence	Worcester
CT (cont'd)	Hartford	Parks		X				X	
		Ecologically Sensitive Habitat		X		X	X	X	X
		Cultural/Historic Properties		X		X	X		X
	Tolland	Parks		X				X	X
		Ecologically Sensitive Habitat		X				X	X
		Cultural/Historic Properties		X				X	X
	Windham	Parks		X				X	X
		Ecologically Sensitive Habitat		X				X	X
		Cultural/Historic Properties		X				X	
	Middlesex	Parks							
		Ecologically Sensitive Habitat	X					X	X
		Cultural/Historic Properties	X			X	X		X
RI	Washington	Parks	X					X	X
		Ecologically Sensitive Habitat	X					X	X
		Cultural/Historic Properties	X					X	
	Kent	Parks	X	X				X	
		Ecologically Sensitive Habitat	X	X				X	X
		Cultural/Historic Properties	X	X				X	
	Providence	Parks	X	X				X	X
		Ecologically Sensitive Habitat	X	X				X	X
		Cultural/Historic Properties	X	X				X	
MA	Bristol	Parks							
		Ecologically Sensitive Habitat	X	X				X	X
		Cultural/Historic Properties	X	X				X	
	Worcester	Parks							X
		Ecologically Sensitive Habitat							X
		Cultural/Historic Properties							X
	Norfolk	Parks	X	X				X	X
		Ecologically Sensitive Habitat	X	X				X	X
		Cultural/Historic Properties	X	X				X	X
	Suffolk	Parks	X	X				X	X
		Ecologically Sensitive Habitat	X	X				X	X
		Cultural/Historic Properties	X	X				X	X

Source: NEC FUTURE team, 2015

Note: Parks, Ecologically Sensitive Habitat, and Cultural/Historic Properties could also be Section 4(f)/6(f) Resources.

Blank cell = No coinciding noise impacts with the resource of interest.

X = Resource presence was noted where noise impact is projected for people living within the Affected Environment.

Table 7.12-11: Environmental Consequences: Affected Environment – Vibration – Summary of Related Resources

Geography	County	Resource of Interest	Summary of Related Resources						
			Alt. 1	Alt. 2	DC-NYC	Alternative 3			
						New York City to Hartford		Hartford to Boston	
						Central CT	Long Island	Providence	Worcester
MD	Baltimore County	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
	Baltimore City	Parks	X	X	X				
		Ecologically Sensitive Habitat	X	X	X				
		Cultural/Historic Properties	X	X	X				
	Harford	Parks			X				
		Ecologically Sensitive Habitat			X				
		Cultural/Historic Properties			X				
	Cecil	Parks		X	X				
		Ecologically Sensitive Habitat			X				
		Cultural/Historic Properties		X	X				
DE	New Castle	Parks			X				
		Ecologically Sensitive Habitat			X				
		Cultural/Historic Properties			X				
PA	Delaware	Parks		X	X				
		Ecologically Sensitive Habitat		X	X				
		Cultural/Historic Properties		X	X				
	Philadelphia	Parks		X	X				
		Ecologically Sensitive Habitat		X	X				
		Cultural/Historic Properties		X	X				
NJ	Middlesex	Parks		X	X				
		Ecologically Sensitive Habitat		X	X				
		Cultural/Historic Properties		X	X				
	Hudson	Parks			X				
		Ecologically Sensitive Habitat			X				
		Cultural/Historic Properties			X				
NY	New York	Parks				X	X		
		Ecologically Sensitive Habitat				X	X		
		Cultural/Historic Properties				X	X		
	Kings	Parks				X	X		
		Ecologically Sensitive Habitat				X	X		
		Cultural/Historic Properties							
	Queens	Parks		X		X	X		
		Ecologically Sensitive Habitat		X		X	X		
		Cultural/Historic Properties		X		X	X		
	Bronx	Parks				X	X		
		Ecologically Sensitive Habitat				X	X		
		Cultural/Historic Properties				X	X		
	Westchester	Parks				X			
		Ecologically Sensitive Habitat		X		X	X		
		Cultural/Historic Properties		X		X	X		

Table 7.12-11: Environmental Consequences: Affected Environment – Vibration – Summary of Related Resources (continued)

Geography	County	Resource of Interest	Summary of Related Resources						
			Alt. 1	Alt. 2	DC-NYC	Alternative 3			
						New York City to Hartford		Hartford to Boston	
						Central CT	Long Island	Providence	Worcester
NY (cont'd)	Putnam	Parks							
		Ecologically Sensitive Habitat							
		Cultural/Historic Properties							
	Nassau	Parks					X		
		Ecologically Sensitive Habitat	X				X		
		Cultural/Historic Properties					X		
	Suffolk	Parks					X		
		Ecologically Sensitive Habitat					X		
		Cultural/Historic Properties					X		
CT	Fairfield	Parks		X		X	X		
		Ecologically Sensitive Habitat		X		X	X		
		Cultural/Historic Properties		X		X	X		
	New Haven	Parks		X		X	X		
		Ecologically Sensitive Habitat		X		X	X		
		Cultural/Historic Properties		X		X	X		
	Hartford	Parks		X				X	
		Ecologically Sensitive Habitat		X		X	X	X	X
		Cultural/Historic Properties		X		X	X		X
	Tolland	Parks		X				X	X
		Ecologically Sensitive Habitat		X				X	X
		Cultural/Historic Properties		X				X	X
	Windham	Parks		X				X	X
		Ecologically Sensitive Habitat		X				X	X
		Cultural/Historic Properties		X				X	
	New London	Parks	X						
		Ecologically Sensitive Habitat	X						
		Cultural/Historic Properties	X						
RI	Washington	Parks	X						
		Ecologically Sensitive Habitat	X						
		Cultural/Historic Properties	X						
	Providence	Parks		X				X	X
		Ecologically Sensitive Habitat		X				X	X
		Cultural/Historic Properties		X				X	
MA	Bristol	Parks							
		Ecologically Sensitive Habitat						X	X
		Cultural/Historic Properties						X	
	Worcester	Parks							X
		Ecologically Sensitive Habitat							X
		Cultural/Historic Properties							X

Table 7.12-11: Environmental Consequences: Affected Environment – Vibration – Summary of Related Resources (continued)

Geography	County	Resource of Interest	Summary of Related Resources						
			Alt. 1	Alt. 2	DC-NYC	Alternative 3			
						New York City to Hartford		Hartford to Boston	
						Central CT	Long Island	Providence	Worcester
MA (cont'd)	Norfolk	Parks						X	X
		Ecologically Sensitive Habitat						X	X
		Cultural/Historic Properties						X	X
	Suffolk	Parks						X	X
		Ecologically Sensitive Habitat						X	X
		Cultural/Historic Properties						X	X

Source: NEC FUTURE team, 2015

Note: Parks, Ecologically Sensitive Habitat, and Cultural/Historic Properties could also be Section 4(f)/6(f) Resources

Blank cell = No coinciding noise impacts with the resource of interest.

X = Resource presence was noted where vibration impact is projected within the Affected Environment. Vibration impacts apply only to resources that contain building structures and do not apply to open land.

7.12.4.3 Alternative 1

In terms of the number of people affected, Alternative 1 would result in 502,520 severe noise impacts, 1,250,650 moderate noise impacts, and 70,480 vibration impacts. The most noise impacts would occur in Fairfield County, CT, where there are new route options in populated areas that deviate from the existing NEC. A high number of noise impacts would occur in Philadelphia County, PA; and Queens, Bronx, and Westchester Counties, NY; New Haven County, CT; Providence County, RI; and Suffolk County, MA, where there are densely populated areas along the route. Vibration impacts for Alternative 1 would be limited to Baltimore City, MD; New London County, CT; and Washington County, RI, where there are new route options that deviate from the existing NEC.

7.12.4.4 Alternative 2

In terms of the number of people affected, Alternative 2 would result in 954,840 severe noise impacts, 1,585,520 moderate noise impacts, and 483,100 vibration impacts. The geographical distribution of noise impacts would be similar to Alternative 1, with generally greater numbers of impacts. However, in certain areas the projected impacts would be fewer for Alternative 2 than for Alternative 1. These areas include Essex County, NJ (where Intercity-Express trains would be diverted through a tunnel section), and areas along the existing NEC from Middlesex County, CT, through Providence County, RI (where Intercity-Express trains would be diverted along a bypass through Hartford, CT). There would also be noise impacts in Hartford, Tolland, and Windham Counties, CT, because of train operations along the bypass through Hartford. For vibration, the greatest number of impacts for Alternative 2 would occur in Queens County, NY, where there would be a new tunnel bypass segment through a densely populated area.

7.12.4.5 Alternative 3

Relative to Alternatives 1 and 2, the Alternative 3 route options, which include many new off-corridor routes with higher train speeds, would have many more noise and vibration impacts. The results are summarized below by route.

Washington, D.C., to New York City

In terms of the number of people affected, the Alternative 3 portion between Washington, D.C., and New York City would result in 953,820 severe and 1,087,580 moderate noise impacts, and 306,100 vibration impacts. The greatest number of noise impacts would occur in densely populated Philadelphia County, PA, and in Middlesex and Union Counties, NJ. For vibration, the greatest number of impacts would occur in Baltimore, MD, and Philadelphia, PA, where there are major new tunnel sections.

New York City to Hartford

Via Central Connecticut

In terms of the number of people affected, Alternative 3 between New York City and Hartford via Central Connecticut would result in up to 934,090 severe and 853,590 moderate noise impacts, and 681,720 vibration impacts. The most noise impacts would occur in densely populated Bronx and Westchester Counties, NY, and in Fairfield County, CT. For vibration, the most impacts would occur in densely populated New York and Queens Counties, NY, because of major new tunnel sections.

Via Long Island

In terms of the number of people affected, Alternative 3 between New York City and Hartford via Long Island would result in up to 877,090 severe and 900,090 moderate noise impacts, and 720,340 vibration impacts. Although these impacts would not be very different than those for the route option via Central Connecticut, slightly fewer noise impacts and slightly more vibration impacts would occur for the route option via Long Island. The greatest numbers of noise and vibration impacts would occur in densely populated Queens County, NY, where the new route option through Long Island begins.

Hartford to Boston

Via Providence

In terms of the number of people affected, Alternative 3 between Hartford and Boston via Providence route option would result in up to 424,730 severe and 470,500 moderate noise impacts, and up to 105,820 vibration impacts. The most noise impacts would occur in densely populated Providence County, RI, and Suffolk County, MA. For vibration, the most impacts would occur in Providence County, where there would be a major new tunnel section.

Via Worcester

In terms of the number of people affected, Alternative 3 between Hartford and Boston via Worcester route option would result in up to 584,980 severe and 634,670 moderate noise impacts, and 247,950 vibration impacts. These impacts are significantly greater than for the route option via Providence. The most noise and vibration impacts would occur along the new route option through densely populated Suffolk County, MA.

7.12.5 Context Area

Within the Context Area, the areas of greatest concern are those with the greatest concentration of residences and parkland. A shift in the Representative Route of any of the Action Alternatives may result in noise and vibration impacts to these sensitive resources.

7.12.6 Potential Mitigation Strategies

Potential noise and vibration mitigation strategies will focus on minimizing impacts at the source (e.g., vehicle treatments, track treatments and horn-free quiet zones), along the transmission path (e.g., sound barriers and track vibration isolation treatments), and at the receiver (e.g., building sound insulation treatments).

7.12.7 Subsequent Tier 2 Analysis

This Tier 1 analysis identifies the number of people, parks, wildlife preserves, cultural resources and historic properties, and Section 4(f)/6(f) resources that would be affected by noise and vibration impacts of the Action Alternatives. However, because of the lack of detailed design information, this Tier 1 Draft EIS does not include a quantitative analysis of impacts from ancillary facilities, stations, and project-related changes in roadway and aircraft traffic. Tier 2 analyses would identify the actual numbers of affected residences, the types of land uses, and locations of sensitive receptors, and would include a quantitative evaluation of potential noise and vibration effects on wildlife and natural parks. The development of mitigation measures and designs that would avoid or minimize noise and vibration effects would also be included in the Tier 2 analyses.